CHAPTER NINE: STEP FOUR - EVALUATION OF ALTERNATIVE PLANS

"We cannot discuss the evaluation of things without knowing what it is that is being evaluated." Frank H. Knight (1885-1972), *Risk, Uncertainty and Profit*, 1926, p. 125.

Step Four: Evaluation of the effects of the alternative plans. (P&G Section III.1.3.2(a)(4))

INTRODUCTION

In the evaluation step, the significant contributions or effects of an individual plan are quantified and judged. That's done for two reasons. *First, the evaluation allows planners to determine whether or not the plan qualifies to advance and be compared against other plans that have independently qualified. Second, evaluation surfaces the specific criteria that will be used to compare those plans that do qualify and advance to the comparison step.*

The purpose of evaluation is to find the value or worth of something. Only the best of the alternatives formulated need to be evaluated in more than a preliminary fashion, but all measures and plans require some evaluation. *Evaluation is a two-part process:* **assessment** *(quantification) and* **appraisal** *(judgment).* Evaluation, like all other planning steps, is also an iterative process. It begins with the first screening of measures and plans and its detail and rigor increases as planning moves closer to a final decision.

This chapter begins with a brief discussion of how to evaluate, that introduces five simple evaluation tasks. After considering what to evaluate, each of these tasks is considered in turn. Qualifying plans requires some criteria or minimum standards that a plan must meet. Candidate criteria comprise the next part of the chapter, which is followed by a discussion of some sample measurement techniques.

The chapter concludes with the consideration of how the evaluation results are to be displayed.

Examples of Things to Evaluate

- NED "benefits"
- Cost estimates (MCACES)
- Real estate appraisals
- Fish and wildlife (HEP, etc.)
- Cultural resources (National Register)
- Water quality (Section 404)
- Regional Economic Development (RED)
- Other Social Effects (OSE)
- Contributions to planning objectives and constraints
- Other

WHAT TO EVALUATE

First, you need **things to measure**. These are resources, plan outputs, and plan effects.[10] *Second, you have to know* **what is important**. It is the important things that are evaluated in this step. There are so many potential effects of a plan that it would be impossible to evaluate them all. The process of determining what is and isn't important begins in the scoping process described in Chapter Five. Significant resources, outputs and plan effects should be evaluated. Effects that tell you whether and how much you are contributing to the planning objectives will be among them.

Other significant effects include changes in NED benefits and costs, measured in dollars. Significant effects can also include many non-monetary effects like many environmental impacts and local concerns that predictably accompany any study (see sidebar).

The criteria for determining significance are institutional, technical and public recognition of importance. There are laws, policies, and other institutional realities that define some resources, project outputs or project effects as important. Other things are clearly important for technical reasons. The ability to move commerce among cities, states and nations is important to economies. Flood problems are important to communities. These things are important for technical reasons. Some study issues are significant because they are important to the public. People care about historical buildings and safety.

The criteria by which we judge a resource (wetlands), an output (navigation), or an effect (community cohesion) significant can be overlapping. Wetlands are important because the public cares about them, because they perform an important function in our ecosystems, and because they are protected by law. Thus, all the criteria point to wetlands as important. It's less important to worry about what makes something important than it is to recognize it as important.

[10] In order to avoid burdensome repetition, "plan effects" will be used to encompass resources and plan outputs as well.

HOW TO EVALUATE?

Evaluation in the six-step planning process requires the planner to perform five tasks. First, forecast a most likely with-project condition for each plan. That means with-project condition scenarios must be developed to describe all important project resources, outputs, and effects. For example, we might need to know what will happen to the habitat of the mottled duck if a plan is implemented.

The second task is to compare the without- and with-project conditions in order to identify any important differences. It may be clear that a plan will increase mottled duck habitat. The third task is to assess, i.e. describe, all important differences that result from the plan. For example, the 400 habitat units expected without a project would be compared to the 500 habitat units with a project to yield an increase of 100 habitat units as a plan effect.

The fourth task is to appraise the differences. In this case, the increase in habitat units may be judged as a significant positive environmental output. The fifth and final step is to qualify plans for further consideration or to drop them. Based on the significant contribution of the plan to mottled duck habitat we decide to consider it further.

Five Evaluation Tasks

1. Forecast a with-project condition for each plan.
2. Compare with- and without-project conditions.
3. Assess, i.e., describe, important differences between the two conditions.
4. Appraise the plan's effects.
5. Qualify the plan for further consideration or drop it.

The main tasks that have to be completed to evaluate plan impacts are shown in the sidebar. *The primary reason for evaluating plan impacts is to qualify plans for further consideration in the comparison step of the planning process*.

…qualify plans for further consideration or to drop them.

The result of the evaluation process is that a plan's effects are identified, measured, and weighed. This can be an informal and subjective process, or it may be a very formal evaluation process. The evaluation step as defined by the P&G (Section III of the Standards paragraph 1.3.6) consists of assessment and appraisal. The first step, assessment, is an objective analysis to identify and measure economic, environmental, social, and other effects expected to result from implementation of the plan. The second step, appraisal, is a more subjective analysis that attempts to classify the importance and desirability of plan effects to plan stakeholders.

Significance

Significance is a confusing term because it has a dual nature. First, we identify resources, conditions and other variables that are significant based on institutional, technical and public criteria. Then we need to determine whether the effects of a specific plan on these variables are significant.

Institutional recognition of an effect means its importance is recognized and acknowledged in the laws, plans, and policies of government, public agencies and private groups. Effects on endangered species and NED impacts are examples. **Technical recognition** of an effect is based upon scientific or other technical criteria that establish the significance of an effect. For example, maintaining salinity levels may be scientifically established as important to the biodiversity of a freshwater marsh. **Public recognition** means some segment of the general public considers the effect important. Public recognition may be manifest in controversy, support, or opposition expressed in any number of formal or informal ways.

Planning objectives and constraints should reflect the views of these institutional, technical, and public interests. But just because a resource has been identified as significant, this does not mean any one plan will have a significant impact on it. Furthermore, some resources may become significant simply because they will be affected. Sound confusing? Consider this. Suppose a wetland is identified as a significant resources. Now suppose Plan A has no impact on that

It is important that all significant plan effects be evaluated fully. Qualification requires it. Plan comparison and selection will be based upon it. Comparison requires a common set of significant impacts across which to make trade-offs. Plan selection will be judicious only if all the significant effects of a plan are known. A thorough evaluation will diminish the possibility of a "surprise" after implementation that could be disturbing to the public or stakeholders. Finally, the reputation of the partners rests on their ability to adequately forecast the effects of projects. This latter point can make an assessment of "no change" as important as a measured assessment of change for certain plan effects.

Therefore, the *significance* of resources, plan outputs, and plan effects is the common thread that runs through all the evaluation tasks. We forecast, compare, and assess only what we believe to be significant. The appraisal task is a formal judgment of a plan's significant effects. Qualification is the evaluation decision to accept a plan for further consideration, i.e., comparison with other qualifying plans, or to drop it from further consideration. The next section discusses each evaluation task in more detail.

EVALUATION TASKS

The evaluation process can be broken down into five tasks, introduced above. Each of these tasks is discussed in turn in the following subsections.

WITH-PROJECT CONDITION

In the second planning step, the most likely future condition without a project is forecast. It provides a benchmark against which an individual plan's effects can be measured. *In step four, the planner must forecast future conditions with the alternative plans in place. A most likely future condition is separately forecast for each alternative*. The important variables measured in step two under the without project condition are

measured again in step four under the with project condition. The resource conditions, project outputs, and plan effects forecast under both the without- and with-project conditions are those that are believed to be significant based on the institutional considerations, technical analyses, and public opinion.

The qualities of a good with condition are similar to those of a good without condition described in Chapter Seven. There may be more than one potential with-project condition. When that is possible, a most likely condition should be identified. The other conditions should be considered in a sensitivity analysis of the plan's effects.

COMPARE WITHOUT AND WITH CONDITIONS

Table 32 provides a simple comparison of a without- and with-project condition comparison. It essentially means forecasting values for a common set of resources, outputs, or effects. In the table we have used population, expected annual flood damages and acres of wetlands as examples of important variables to forecast and compare.

Table 32: Compare Without and With Plan Conditions

Effect	Without Conditions	Plan A Condition
Population	147,000	147,000
Expected Annual Damages	$2.1 million	$0.7 million
Wetland Acres	412 acres	258 acres

This evaluation task involves only Plan A. Note that the differences have not yet been assessed. Plans B, C, and others will also be separately evaluated. Only important effects should be compared.

How do you know what an important effect looks like? Once again, we fall back on the criteria of institutional, technical, or public recognition of importance. Planning objectives are by definition important effects. These define the reasons for your study and were specified because they were recognized as important. Each plan should be evaluated against the planning objectives. As for other effects, does anyone say an effect is important? Do either of the partners or a significant stakeholder consider an effect important? Is there legislation that defines an effect as important? Do your technical experts say it's important? These are the ways we recognize important effects. More is said about importance in the assessment section that follows.

ASSESSMENT: DESCRIBING DIFFERENCES

Once you have identified an effect as important you **need a way to measure it.** Describing differences between without- and with-project conditions is the primary means of measuring plan effects. Measurement means describing the duration, location and magnitude of a plan effect as precisely as possible. *Measurement should be quantitative whenever possible*. If an impact can be measured in dollars, habitat units, acres or any other common metric, it should be.

Quantitative measurement is not the only kind of measurement. Effects can be assessed in a subjective manner. Subjective rankings of effects may be possible when quantitative measurements are not. We may not have any metric that quantifies scenic beauty, but it may be entirely possible to say that Plan A contributes to scenic beauty or that it does not. Without some means of measurement, assessment cannot proceed. The general framework for assessing plan effects is the without- and with-project conditions comparison.

Table 33 presents the comparison of without- and with-project conditions for Plan A, with the differences in the two conditions assessed. If it is not obvious from the context, the location and duration of differences should be identified. For example, there is a $1.4 million reduction in expected annual damages downtown over the economic life of the project. Downtown was specified, the economic life of the project is implicit.

Table 33: Assessment of Plan Effects

Effect	Without Condition	Plan A Condition	Differences
Population	147,000	147,000	No difference
Expected Annual Damages downtown	$2.1 million	$0.7 million	$1.4 million reduction
Wetland Acres the river	412 acres	258 acres	154-acre decrease along

With less data or earlier in the planning process, we might have had to rely on a subjective assessment of the differences due to plan A. For example, the magnitude of effects might have been no change in population, a decrease in flood damages, and a decrease in wetland acreage. The description of differences should be as quantitative as possible.

MEASUREMENT PROCEDURES

A great deal of guidance already exists for the evaluation of plan effects. The P&G contain specific evaluation procedures for estimating NED benefits and costs as well as a set of procedures for evaluating environmental quality effects of a plan. Many of these evaluation procedures have been supplemented by additional guidance. Most notable among this guidance is the series of **National Economic Development Procedures Manuals** and the Evaluation of Environmental Investment Research Project reports prepared by the Institute for Water Resources. These manuals and reports provide additional guidance and examples detailing evaluation procedures. These manuals are listed in Appendix I.

There are some rather handy subjective evaluation techniques that are quite appropriate for early iterations of the planning process. "Is there any possible way this could work?" might be a question to ask of a plan early in the planning process. If the answer is yes, it qualifies for further consideration.

"Is there any possible way this could work?"

As the evaluation process matures, the evaluation techniques evolve from totally subjective measures like the above question to very objective measures, such as those found in the NED manuals. In between are several other simple techniques and metrics. Before data are available or for impacts that are fundamentally subjective judgments, e.g., contributions to community cohesion, there are any number of ways to evaluate.

The idea is to provide an evaluation of each screening criterion on a plan-by-plan basis. It is perfectly acceptable to use a different evaluation technique for each criterion. We would expect NED costs and habitat units lost to be measured in different ways. It is also expected that any given criterion will be evaluated the same way for all plans that are at comparable stages in the planning process.

Scales are a common means of making subjective judgements. This simply ranks a plan on a scale of 1 to 5, or any other convenient scale, where 1 might be "very negative impact" and 5 a "very positive impact" with 3 "no impact."

Using ratings of +/0/-/? is another common means of evaluating plans. If it makes a positive contribution it gets a plus sign, no contribution is a zero, a negative contribution is a minus sign. The question mark is for when we don't know the impact.

Index *numbers can be used for some impacts*. An index of 100 is arbitrarily affixed to some ideal level of attainment of an objective. Plans can then be evaluated with numbers greater or less than 100 that show the plans achievement relative to that ideal level.

APPRAISING PLAN EFFECTS

The appraisal task in the evaluation step requires the planner to determine the value and significance of the differences they have described.. This is the last step before determining whether a plan qualifies for the next round of consideration or not. It is a values-based evaluation step in contrast to the more objective measurement of the assessment step. Judge the impact. Is it good or bad? Is it important or not?

Every impact that was assessed should be appraised. It is during this task that the determination of an effect's significance comes to the fore. *There is a difference between making a value judgment about an effect and determining if it is significant*, as was pointed out in the earlier sidebar. Determining an effect's magnitude, duration and location is part of the assessment. You only assess those effects you believe to be significant. In the appraisal you determine whether the assessed difference is beneficial or adverse, and significant or not. This means considering each plan's contributions to the planning objectives and constraints, its NED benefits and costs, its environmental impacts and whatever other effects have been deemed significant in your study.

You can usually categorize an effect as good or bad.

The first step in the appraisal is to determine if the assessed effect is adverse, beneficial, or neutral. Fewer flood damages is good, fewer wetland acres is bad. You can usually categorize an effect as good or bad. *It may be more difficult to say how good or how bad it is, the second step in the appraisal task*. The loss of wetlands will, for example, always be bad and it will always be important. Noise during construction will always be bad, but is it significant? The answers to such questions will have to be given on a case-by-case basis. Appraisals are by nature subjective judgments.

Appraisals are by nature subjective judgments.

QUALIFYING PLANS

Hundreds of plans can be conceived of during the plan formulation process. Not all of them deserve to be considered for long. Certainly, relatively few of them will ultimately be compared against others to determine the best of all possible plans. *Perhaps the most important purpose of the evaluation step is to qualify plans for further consideration*.

Formal evaluation of alternative plans raises the screening process to new levels of sophistication. Early in the formulation process a plan can be eliminated because "it's a goofy idea," "it'll never work," and similar subjective evaluation criteria. As the planning process matures, so must the evaluation techniques. At some point, evaluation must come back to the planning objectives and constraints.

The purpose of the evaluation step is to carefully examine each alternative and determine if it is worthy of additional consideration. This is accomplished by holding each plan to a frequently subjective and always study-specific set of minimum standards. *A potential plan has to meet some minimum standards in order to merit further consideration. Criteria are needed to determine those minimum standards*. Each plan, taken individually and without comparison to any other plan, can be evaluated against the qualifying criteria to determine whether or not it qualifies for additional consideration. That is, is the plan good enough? This is the culmination of the evaluation process.

Subjective judgments of a single plan tend to be pass/fail, go/no go, enough/too much types of statements. These are as opposed to the types of subjective judgments made in the comparison step when you can use more than/better than/less than types of statements. *The standards for determining enough, too little, go, and so on are related to the significance of the plan's effects on significant factors*. At the completion of the appraisal task, we'd like to have sufficient information to determine whether a plan is good enough to qualify for the next round of analysis, comparison of plans.

If a plan's qualifications are not readily apparent based on any single screening criterion we need to consider it's overall qualifications. Once each effect has been appraised, the next task in the evaluation process is to judge the plan in light of its overall contributions to our evaluation criteria. The focal point for doing this should be appraising the specific plan's contributions to the planning objectives. We are seeking some degree of "objective fulfillment." Are the plan's effects on planning objectives good or bad? Does it qualify?

If the plan is good enough it will eventually be compared to other plans at a comparable level of development in the planning process. If a plan does not qualify, it is dropped from further consideration. What criteria do you evaluate a plan against to determine if it qualifies for further consideration? They include all significant resources, outputs and plan effects. Significant plan effects must include contributions to planning objectives and constraints. They also include the Federal objective, environmental compliance requirements, what is important to stakeholders, and the P&G's four evaluation criteria.

QUALIFYING CRITERIA

To determine whether a plan qualifies for further consideration, planners need some criteria. Some of the things we know are going to be recognized as significant by institutions, technical analysis or the public are predictable and are discussed in the following subsections.

PLANNING OBJECTIVES AND CONSTRAINTS IN EVALUATION

The tasks described above make frequent reference to qualifying criteria, minimum standards each plan must separately meet, in order to be considered further. These minimum standards may represent the required degree of objective fulfillment. The degree of objective fulfillment may be empirical (e.g., reduce flood damages by at least 25 percent or increase habitat by 50 habitat units) or it might be subjective (enough/not enough). In either case, the culmination of the evaluation step is a decision whether to continue to consider the plan just evaluated.

The planning team will have to establish some minimum standards of objective fulfillment for qualifying a plan for further consideration. These standards can be based on contributions to the most important objectives contributed to, the number of objectives, the size of the contribution, or any other standards that make sense at a particular point in the study. It is, however, important to bear in mind that *this is not a comparison of plans. It is a simple qualifying round*. It is akin to determining whether your tomato is good enough to enter in the county fair. You can worry about whether it's the best tomato if and when you get it into the fair.

FEDERAL OBJECTIVE

For most water resource planning, estimates of NED costs and benefits are going to be needed. *A plan that does not have benefits in excess of costs would normally not qualify for further consideration*. Although ecosystem restoration projects are not justified based on an NED benefit-cost analysis, it is still necessary to identify their costs and, in the interest of full disclosure, the economic benefits they would produce. NED benefits and costs are clearly criteria that can result in a pass/fail evaluation of a plan.

…establish some minimum standards for qualifying…

ENVIRONMENTAL COMPLIANCE REQUIREMENTS

Environmental compliance requires that each plan meet minimum standards with respect to significant resources like endangered species, cultural resources, and so on. IWR Report 96-PS-3, "Civil Works Environmental Desk Reference," summarizes the potentially applicable Federal requirements. These will be important qualifying criteria once identified. A plan that does not meet these minimum standards will not qualify for further consideration.

OTHER IMPACTS

There may be other impacts not covered among the above criteria that are important to people. If so, they should be included among the qualifying criteria. These will typically be effects important to key stakeholders.

P&G SCREENING CRITERIA

The P&G (Paragraph 1.6.2(c)) suggest the use of four evaluation criteria -- completeness, effectiveness, efficiency and acceptability -- in the screening of alternative plans. Plans that require substantial activity by others, that is not likely to be forthcoming, in order to reach a "go" appraisal for critical objectives are not complete. Plans that are not appraised as a "go" for planning objectives are not effective. Plans that achieve contributions to objectives at higher costs, whether objectively or subjectively measured, are not efficient. Plans with effects that result in infeasibility are not acceptable. Minimum standards for these four criteria must be established in order to determine whether a plan is worthy of additional consideration.

These standards will generally be subjective, where each plan is measured on a continuum. Figure 7 illustrates the point conceptually. The thin line represents a subjective minimum standard for each of these criteria. The hypothetical plan has exceeded the standard for completeness and acceptability but it has failed to measure up under the effectiveness and efficiency criteria. As long as a plan exceeds the minimum standard for each criterion it qualifies for further consideration and comparison with other plans. This plan would have to be modified to be more effective and efficient or it will be dropped from further consideration. Each criterion is discussed in turn below.

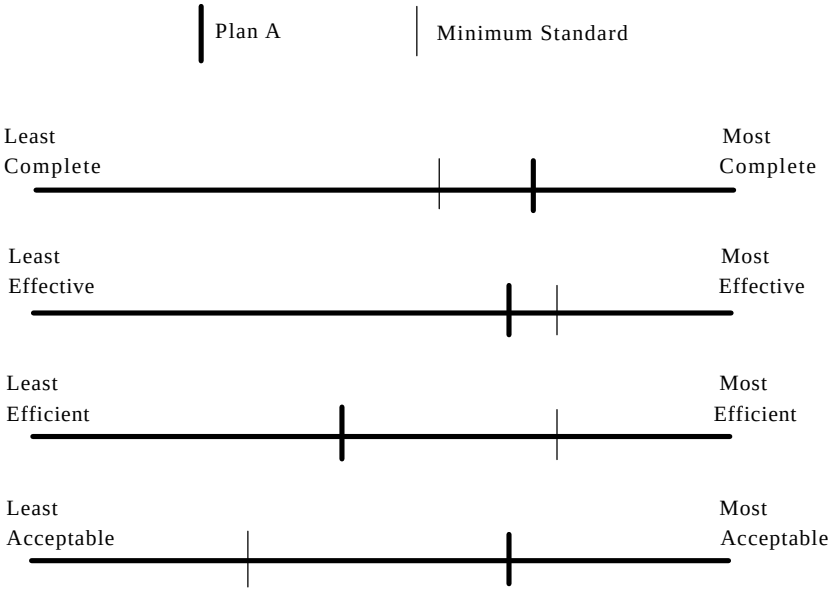
Completeness

> "Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective." (P&G Section VI.1.6.2(c)(1))

A complete alternative is…well thought out.

A complete alternative is one that is well thought out. All the necessary implementation actions have been accounted for in the planning process. During the planning

Figure 7: Screening and Evaluation Criteria



process, before plans are likely to be complete, this criterion will be of limited use for screening.

Once plan effects have been identified, it is important to scrutinize the plan to ensure that it includes all that is necessary to realize the plan effects. This means considering those things beyond the planners' control as well as those things beyond the scope of the Corps' program and the local partner's commitment. For example, a plan that relies on a strong economy or world petroleum markets to produce all of the navigation benefits forecast is not as complete as a plan whose benefits do not depend on factors beyond the control of the planners.

To establish the completeness of the plan, it is helpful to list those factors beyond the control of the planners that are required to make the plan effects a reality. If a plan's effects, like project benefits, will not be realized unless there is a strong international economy, dredging of private berths, and relatively peaceful conditions in the oil-producing nations, these factors must be identified. The plan is not complete unless these conditions are met.

Effectiveness

> "Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities." (P&G Section VI.1.6.2(c)(2))

An effective plan is responsive to the wants and needs of people. An effective plan makes a significant contribution to the solution of some problems and achieves some opportunities. In other words, it contributes to the attainment of the planning objectives.

The most effective alternatives make significant contributions to all the planning objectives. "Effectiveness," then, becomes an imprecise matter of degree. How much does an alternative contribute to how many planning objectives? The answer determines how effective an alternative it is.

In the screening process, it is often possible to identify alternatives that make little or no contribution to the planning objectives. When this is the case, these alternatives can be rejected because they are relatively ineffective. When the formal evaluation process has been completed, the extent of a plan's effectiveness may well be quantified, facilitating a more objective application of this criterion.

Efficiency

> "Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment." (P&G Section VI.1.6.2(c)(3))

When you think about cost-effectiveness, don't think only about dollar costs. Costs refer not just to the number of dollars that will have to be paid to implement a plan, but to opportunities that will be sacrificed if the plan is implemented.

Efficiency refers to the allocation of resources. Are resources used efficiently in the construction of a project or the implementation of a plan? Are the outputs produced by the plan produced in an efficient manner? Are the resources that are going to be significantly affected by the plan still going to be available for efficient use by society?

The more familiar articulation of the criterion of efficiency is **cost-effectiveness**. Of all the ways of developing and implementing a plan, have we identified the lowest cost means of implementation? An obvious question is, is there a cheaper way to accomplish the same planning objectives? If there is, we do not have a cost-effective plan.

The efficiency criterion transcends the NED criterion. When all tangible/monetary and intangible/non-monetary costs are considered, do we have the plan that meets objectives in the least costly fashion? If a plan costs society the loss of some wetlands and there is another way to achieve the same objectives with no or less wetland loss, the plan is not efficient.

Efficiency must be considered in light of all opportunity costs, not just monetary costs. This makes the efficiency criterion considerably more difficult for

planning for the Corps' environmental mission, because planners may have to trade-off increased implementation costs against less environmental losses.

Acceptability

> "Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies." (P&G Section VI.1.6.2(c)(4)

If a plan has opposition…that doesn't make it unacceptable.

There are two primary dimensions to acceptability. One we call **implementability***, meaning is it feasible in the technical, environmental, economic, social, and similar senses? The other is the* **satisfaction** *it brings*. A common error that must be avoided with this criterion is the tendency to equate acceptability with the non-Federal partner's willingness to sign a Project Cooperation Agreement for the plan. It's often thought if they would sign, the plan is acceptable; if they wouldn't, it is not. This is <u>not</u> what acceptability means. If it were, there would be no need for a partnership or a planning process at all. The local partner would need only say, "this is what we want," and it would become the only acceptable plan.

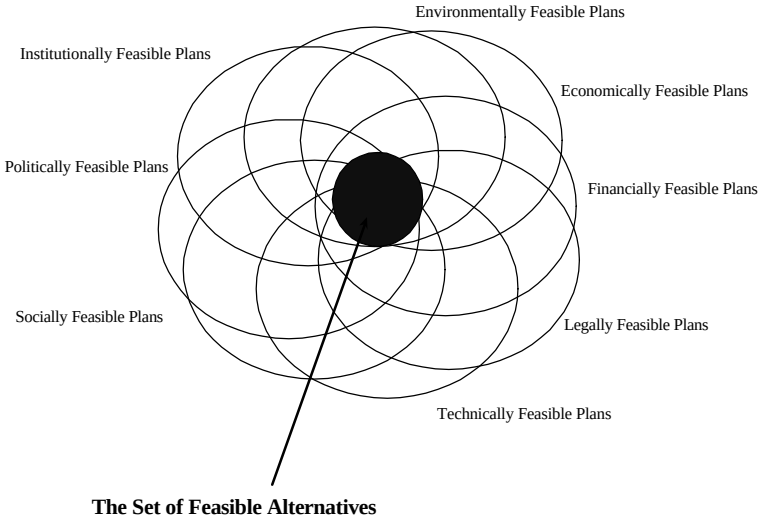
To be acceptable to state and local entities as well as the public, a plan has to be doable. There are many factors that can render a plan infeasible. These factors can generally be categorized as technical (engineering or natural world limitations), economic, financial, environmental, social, political, legal, and institutional. Figure 8 illustrates this notion of feasibility.

If a plan cannot be done for legitimate reasons, it is not feasible. If a plan has opposition or is not the favored plan of the non-Federal partner that does not make it infeasible or unacceptable. That simply makes it unpopular. If a plan requires changes in laws or authorities, that alone doesn't make it unacceptable. That only makes it difficult.

Acceptability can also be defined as the extent to which a plan is welcome or satisfactory. These are qualitative dimensions, not absolutes. If a plan is feasible in a pragmatic sense, in that it could be done, there is no objective way to determine what is welcome or unwelcome, satisfactory or unsatisfactory. This is not a pass/fail criterion.

Acceptability may be the most useful criterion for eliminating potential alternatives. In the formal evaluation stage there will be more fully developed and documented rationales for the elimination of alternatives based on feasibility. Though the satisfaction of a plan will remain subjective, sufficient measurement,

Figure 8: Screening Plans



appraisal, and comparison will have been completed to support judgments about which plans and versions of plans are acceptable enough to carry forward for further consideration.

Not coincidentally, when the team carefully evaluates a plan, they are providing a firm basis for the comparison step. The resulting information about effects will form the basis for the comparison step.

ORGANIZING EVALUATION RESULTS

Evaluation can result in a great deal of information.

Evaluation can result in a great deal of information. That information is useless unless it improves decision-making. To be most useful to decision-makers, it must be effectively organized for consideration by team members, stakeholders, the public and partnership decision-makers for use in the comparison step.

The P&G established four accounts to facilitate evaluation and the display of the effects of alternative plans. These accounts have been devised to encompass all significant effects of a plan as required by the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and Section 122 of the Flood Control Act of 1970 (PL 91-611, 84 Stat. 1823).

THE SYSTEM OF ACCOUNTS

The system of accounts is one way to organize and keep track of the effects of alternative plans. Think of it as a set (system) of effect categories (accounts). It's simply one way of dividing the universe of potential plan impacts into four fairly robust categories. The accounts established by the P&G include **national economic development** (NED), **regional economic development** (RED), **environmental quality** (EQ), and **other social effects** (OSE). All of the evaluated plan effects are assigned to and displayed in one of these four categories. Strictly speaking, only the NED account is required, though it is common practice to use the four-account system. A sample is shown in Table 34. Note the table title indicates a summary comparison. The comparison is to be based upon the results of plan-by-plan evaluation.

Why bother with a display like this system of accounts? Establishing the system of accounts is a bookkeeping exercise with several important aspects. First, all effects important to decision-making can be shown somewhere in the accounts. Second, NED effects must be explicitly shown because they are the basis for establishing the economic feasibility of the plan. Third, it is a rational, organized framework for presenting the results of your analysis. It also provides a handy means for readers to compare plan effects.

You are not restricted to these four accounts. If it is convenient to present a wetlands account or subaccount for a restoration study, or a water use account for a drought study, or town impacts account for a Section 14 streambank erosion study, then by all means do so. Though the four-account system is robust enough to accommodate virtually any plan effect, the P&G permit the use of any system of accounts or alternative display of plan effects as long as NED effects are displayed.

Some planning efforts such as those for military installations, for regulatory actions, and for O&M dredging, are not subject to the P&G. Nonetheless, the generic idea of organizing plan impacts and displaying them in a set of categories in which the categories are based on the specific needs of the study is not a bad idea.

National Economic Development

> "Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed." (P&G Section II(b))

The NED account is the account that includes the estimates of project benefits and costs used to calculate net economic benefits, upon which the economic feasibility of traditional plans rests. The NED account is the successor to the historical objective of economic development that has run throughout the history of

Table 34: Summary Comparison of Detailed Plans for Duck Creek, Ohio [11]			
	No Action	**NED Plan**	**Locally Preferred Plan**
1. PLAN DESCRIPTION	No Action/Without Project Condition	Reach DC-A 25-year protection; Reach DC-B 600-year protection; & Reach DC-C 100-year protection	Sections DC-A, DC-B, DC-C Uniform 100-year level of protection
2. IMPACT ASSESSMENT			
A. National Economic Development (NED)			
(1) Project Cost (2) Annual Cost (3) Total Annual Benefits (4) Annual Net Benefits (5) Benefit to Cost Ratio	$0 $0 $0 $0 N/A Ranks 3rd	$13,895,000 $ 1,357,000 $ 1,721,000 $ 364,000 1.27 Ranks 1st	$14,817,000 $ 1,445,000 $ 1,783,000 $ 338,000 1.20 Ranks 2nd
B. Environmental Quality (EQ)			
(1) Air/Noise	Normal noise levels created by traffic, business, and industrial activities. Ranks 1st.	Temporary increased noise levels during 4-year construction period. Ranks 2nd.	Temporary increased noise levels during 4-year construction period. Ranks 3rd.
(2) Water Quality	Existing water quality is poor due to discharges into the stream from combined sewer system outfalls and flood runoff from industrial areas adjacent to the stream. Ranks 3rd.	Temporary increased turbidity levels during 4-year construction period. Contamination from flood runoff from adjacent industrial areas partially eliminated in DC-A, and fully eliminated in DC-B and DC-C. Ranks 2nd.	Temporary increased turbidity levels during 4-year construction period. Contamination from flood runoff from adjacent industrial areas eliminated for all reaches. Ranks 1st.
(3) Vegetation	Existing vegetation typical for streams in Southwest Ohio. Excellent habitat for woodland songbirds and urban wildlife. Ranks 1st.	Permanent loss of 12 acres to project features; temporary loss of 8 acres during 4-year construction period. Ranks 2nd.	Permanent loss of 13 acres to project features; temporary loss of 8 acres during 4-year construction period. Ranks 3rd.
(4) Threatened & Endangered Species	No endangered species in work area.	No impact.	No impact
(5) Aquatic Birds	Existing biological community sparse due to pollutant discharges from combined sewer systems outfalls. Ranks 3rd	Temporary decreased biota populations during 4-year construction period. Possible increase in biota population with decrease in contaminant runoff from protected industrial areas. Ranks 1st (Tie).	Temporary decreased biota populations during 4-year construction period. Possible increase in biota population with decrease in contaminant runoff from protected industrial areas. Ranks 1st (Tie).
(6) Cultural Resources & Historic Properties	No cultural resources or historic properties in work area.	No impact.	No impact.
C. Regional Economic Development (RED)	Same as National Economic Development (NED) impacts. Ranks 3rd.	Same as National Economic Development (NED) impacts. Ranks 1st	Same as National Economic Development (NED) impacts. Ranks 2nd.
D. Other Social Effects (OSE)			

Table 34: Summary Comparison of Detailed Plans for Duck Creek, Ohio [11]			
(1) Life, Health and Safety	Little or no residential threat. Commercial and industrial property with over 1,000 employees during normal shifts have continued exposure to threat of loss of life, and disruption of health & safety services. Red Bank and Madison Roads flood beginning at 25-year event. Ranks 3rd.	Provides only 25-year level of protection to area DC-A, 500-year to DC-B, and 100-year to DC-C. Red Bank Road flooded by events greater than 25-year. Madison Road will require installation of closures for 10-year floods and higher, with 3 to 4 possible false alarm closures each year. Ranks 2nd.	Provides 100-year level of protection to all damage areas along Duck Creek. Red Bank Road flooding eliminated. Madison Road will require installation of closures for 10-year floods and higher. Other false alarm closures may occur 3 to 4 times a year. Ranks 1st.
(2) Community Cohesion (displacement of people & businesses)	Future flooding and in particular, occurrence of large flooding events, could displace selected businesses over time. Ranks 3rd.	Some displacement of businesses is possible in low-level protection area DC-A. Displacement of portion of one small business by plan. Ranks 2nd.	100-year level of protection to all homes and businesses in the study area. Displacement of portion of one small business by plan. Ranks 1st.
(3) Recreation	No existing recreation facilities in the study area floodplain. Ranks 3rd.	Existing low intensity use recreation facility downstream of study area to be used for environmental mitigation site. Compatible with facility master plan. No opportunity or interest by local partners to add other recreation features to proposed plan. Ranks 1st (Tie).	Existing low intensity use recreation facility downstream of study area to be used for environmental mitigation site. Compatible with facility master plan. No opportunity or interest by local partners to add other recreation features to proposed plan. Ranks 1st (Tie).
3. PLAN EVALUATION			
A. Contribution to Planning Objectives			
(1) Efficiently reduces flood damages to maximum practical extent	Average Annual Flood Damages (AAD) are $1,844,000. No effective reduction from limited private non-structural measures. Does not meet objective. Ranks 3rd.	Residual AAD = $174,000 for a 91% reduction in AAD. Meets objective. Ranks 2nd.	Residual AAD = $113,000 for a 94% reduction in AAD. Meets objective. Ranks 1st.
(2) Provide optimum level of flood protection	Damage outputs starting at the 2-year flood level. Does not meet objective. Ranks 3rd.	Provides 25-year DC-A, 500-year DC-B, & 100-year DC-C, NED plan. Meets objectives. Ranks 1st.	Provides uniform 100-year flood protection for all reaches. Meets objectives. Ranks 2nd.
(3) Minimize environmental impacts	Existing vegetation typical for streams in southwest Ohio. Excellent habitat for woodland birds and urban wildlife. Meets objective. Ranks 1st	Permanent loss of 12 acres to project features; temporary loss of 8 acres during 2-year construction period. Temporary disturbed areas to be restored. Enhancement of offsite wildlife areas for mitigation. Contamination from flood runoff from adjacent industrial areas partially eliminated in DC-A, fully eliminated in DC-B and DC-C. Meets objective. Ranks 2nd.	Permanent loss of 13 acres to project features; temporary loss of 8 acres during 4-year construction period. Temporary disturbed areas to be restored. Enhancement of offsite wildlife areas for mitigation. Contamination from flood runoff from adjacent industrial areas eliminated for all reaches. Meets objective. Ranks 3rd.

Table 34: Summary Comparison of Detailed Plans for Duck Creek, Ohio [11]			
B. Response to Planning Constraints			
(1) Financial capability of local partners to cost-share project construction	N/A	Local cost share of $3,474,000 is within local capabilities. Meets constraint.	Local cost share of $3,704,000 is within local capabilities. Meets constraint.
(2) Institutional acceptability	Red Banks and Madison Roads flood beginning at 25-year event flood waters. Ongoing high level of flood damages not acceptable to local partners. Does not meet constraint.	Red Bank Road flooded by events greater than 25-year. Madison Road will require installation of closures for 10-year floods and higher, with 3 to 4 possible false alarm closures each year. Non-uniform level of protection not acceptable to local partners, but acceptable under Federal criteria. Partially meets constraint.	Red Bank Road flooding eliminated. Madison Road will require installation of closures for 10-year floods and higher. Other false alarm closures may occur 3 to 4 times a year. Uniform 100-year level of protection acceptable to local partners and meets Federal criteria. Meets constraint.
(3) Public acceptability	Not acceptable. Does not meet constraint.	Not fully acceptable. Partially meets constraint.	Fully acceptable. Meets constraint.
C. Response to Evaluation Criteria			
(1) Completeness	Does not meet objective.	Partially meets objective.	Meets objective.
(2) Effectiveness	Does not meet objective.	Meets objective.	Meets objective.
(3) Efficiency	Does not meet objective.	Meets objective.	Meets objective.

[11] The table is a system of accounts display taken from a Corps report. It was prepared prior to the requirements for a risk-based analysis of flood protection levels. Hence, references to 25-year protection and so on would no longer be used in such a display.

water resource development in the U.S. The NED account has been described at great length in a series of IWR procedures manuals. Two of these deal with the NED objective in an overview fashion and should be of particular interest to planners. One, the "National Economic Development Procedures Manual - Overview Manual for Conducting National Economic Development Analysis" deals with NED benefits. The other, "National Economic Development Procedures Manual - National Economic Development Costs", deals with the adverse effects of plans on the NED account.

NED Decision Criteria

Once all benefits and costs have been expressed at comparable price levels and at comparable points in time, usually average annual equivalent dollars, it's possible to calculate two different comparisons of benefits and costs.

Net benefits is defined as average annual equivalent benefits minus average annual equivalent costs. Economic feasibility requires that net NED benefits be non-negative. The NED plan is the plan that maximizes net benefits.

The benefit-cost ratio (BCR) is defined as average annual equivalent benefits divided by average annual equivalent costs. Economic feasibility requires that the BCR be equal to or greater than one. The BCR is not used to identify the NED plan.

In some cases where benefit estimates are unavailable, cost effectiveness and incremental cost analyses may be used. Cost effectiveness means choosing the least costly means of producing like amounts of output.

Regional Economic Development

> "The RED account registers changes in the distribution of regional economic activity that result from each alternative plan. Two measures of the effects of the plan on regional economies are used in the account: regional income and regional employment." (P&G Section VII.1.7.4(a)(1)).

This account is mentioned second simply because of its close relationship to the NED account. Not all economic effects, beneficial or adverse, have national implications. For example, a plan may prevent a manufacturer from leaving one area to locate in another. From a national perspective, there is no difference. The manufacturer would still be producing his wares in the U.S. From the regional

perspective the manufacturer's location will be of great importance because of the jobs, income, and tax revenues he produces.

This regional perspective…has become increasingly important to non-Federal partners…

This regional perspective, particularly as it relates to the effects of plans on jobs, income, and tax bases, has become increasingly important to non-Federal partners as they have been required to help finance studies and projects. Regional interests want to know more precisely what they are getting for their money. If an NED perspective is intended to protect the national interest in projects, it only stands to reason that as the non-Federal financial stake increases, an RED perspective is required to address the regional and local interests in a project.

There is less Corps' guidance on regional economic analysis but it is the primary type of analysis addressed in the economic literature. There are no shortages of methods, tools, or techniques for conducting RED analysis.

Environmental Quality

> "Beneficial effects in the EQ account are favorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources. Adverse effects in the EQ account are unfavorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources." (P&G Section VII.1.7.3(a)(2&3)

Environmental quality is the successor to the preservationist thrust that began earlier in the history of water resource development in the U.S. Consideration of EQ effects, as well as all effects on the quality of human environment, is required by NEPA 1969. Chapter III of the Guidelines is devoted exclusively to procedures for conducting an EQ evaluation. This remains the best source of a detailed description of the EQ assessment and appraisal processes for all planners. ER 1105-2-100, beginning in Section V of Chapter 7, offers additional procedures for environmental evaluation. Sections VI through IX describe ecological resources, historical preservation, aesthetic resources, and water quality and related requirements.

Other Social Effects

> "The OSE account is a means of displaying and integrating into water resource planning information on alternative plan effects from perspectives that are not reflected in the other three accounts. The categories of effects in the OSE account include the following: Urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation." (P&G Section VII.1.7.5(a)(1))

The OSE account lends the system of four accounts the flexibility to address any effects that are judged significant by any stakeholder, if the planning team so desires. This is the account that reflects anything that affects the well being of people. All the difficult issues of equity, income distribution, fairness, and the like are included here.

Less has been written about OSE evaluation procedures than any other account. Most of what has been written on this topic with regard to water resource projects dates back to the late sixties and early seventies when inclusion of well-being as a national objective was being debated. One of the best sources for Corps planners is the "Proceedings of the Social Scientists Conference, Memphis 20-24 September 1976" produced by IWR in two volumes dated December 1977.

DISPLAYING EVALUATION RESULTS

The P&G, in Section VIII, provide some general guidance on the nature of graphs, tables, drawings, photographs, summary statements, and other graphics used to analyze and compare plans. Conciseness and clarity are prized most of all. Displays of evaluation results should make the plans' contributions to solving problems and seizing opportunities clear. The plans' effects presented in the system of accounts should ideally relate to the plans' contributions to planning objectives. The effects of the plans should be so arranged that the differences among the plans will be evident for the comparison of plans that is to follow the evaluation step.

Conciseness and clarity are prized most of all.

The P&G empower the agency to define report content and format. However, they require (1) a clear description of existing and forecast conditions without the plan in place; (2) alternative plans fully described in terms of their component measures, NED effects and other significant effects; (3) the effects of the recommended plan on natural and cultural resources displayed in detail; (4) a matrix showing other projects or actions related to the recommended plan; and, (5) a description of the formulation process. How to tell your story is discussed at length in the last chapter of this manual.

SUMMARY AND LOOK FORWARD

Lesson One. Evaluation comprises an objective assessment of plan effects and a subjective appraisal of the assessed effects.

Lesson Two. The first goal of evaluation is to qualify plans for further consideration. The second goal is to facilitate the eventual comparison of plans. Plan evaluation provides the basis for reducing the set of potential alternative plans to a set of finalists.

Lesson Three. A most likely with-project condition is described for each alternative plan. Effects are evaluated on the basis of a without- and with-project condition comparison.

Lesson Four. Detailed evaluation procedures have been developed for many NED, EQ, and physical effects of plans.

Lesson Five. The four accounts provide a detailed and flexible framework for identifying and summarizing plan effects.

Once plan effects have been evaluated and displayed effectively, they must be compared so planners can identify and describe significant trade-offs to decision-makers who will select the best plan.

SUGGESTIONS FOR FURTHER READING

The various disciplines used in planning provide guidance on how to evaluate specific types of plan impacts. For example, there are countless books and articles discussing the estimation of regional economic development impacts. As it turns out, the discipline based literature is often the best place to look for more help on evaluation of impacts.

The water resources planning literature cited at the end of Chapter Two provides some discussion of these concepts in a water resources context. There is relatively little substantive content found there, however. Don't overlook the possibility of finding something good in a Corps report. If you get a chance to thumb through some reports, look and see how they handled the evaluation of plans. Good ideas are worth repeating.